Life-Cycle Integration and Validation Element

Industry/Academia Workshop

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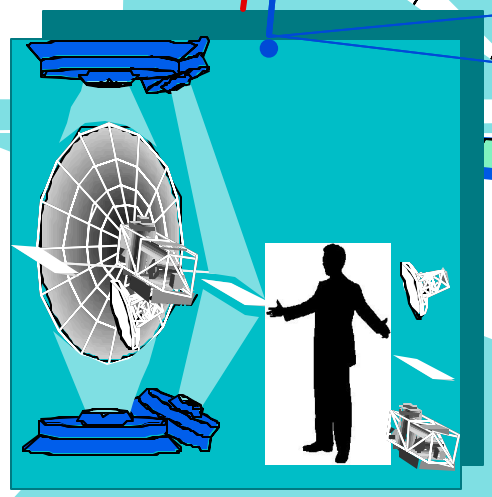
LCIV Vision

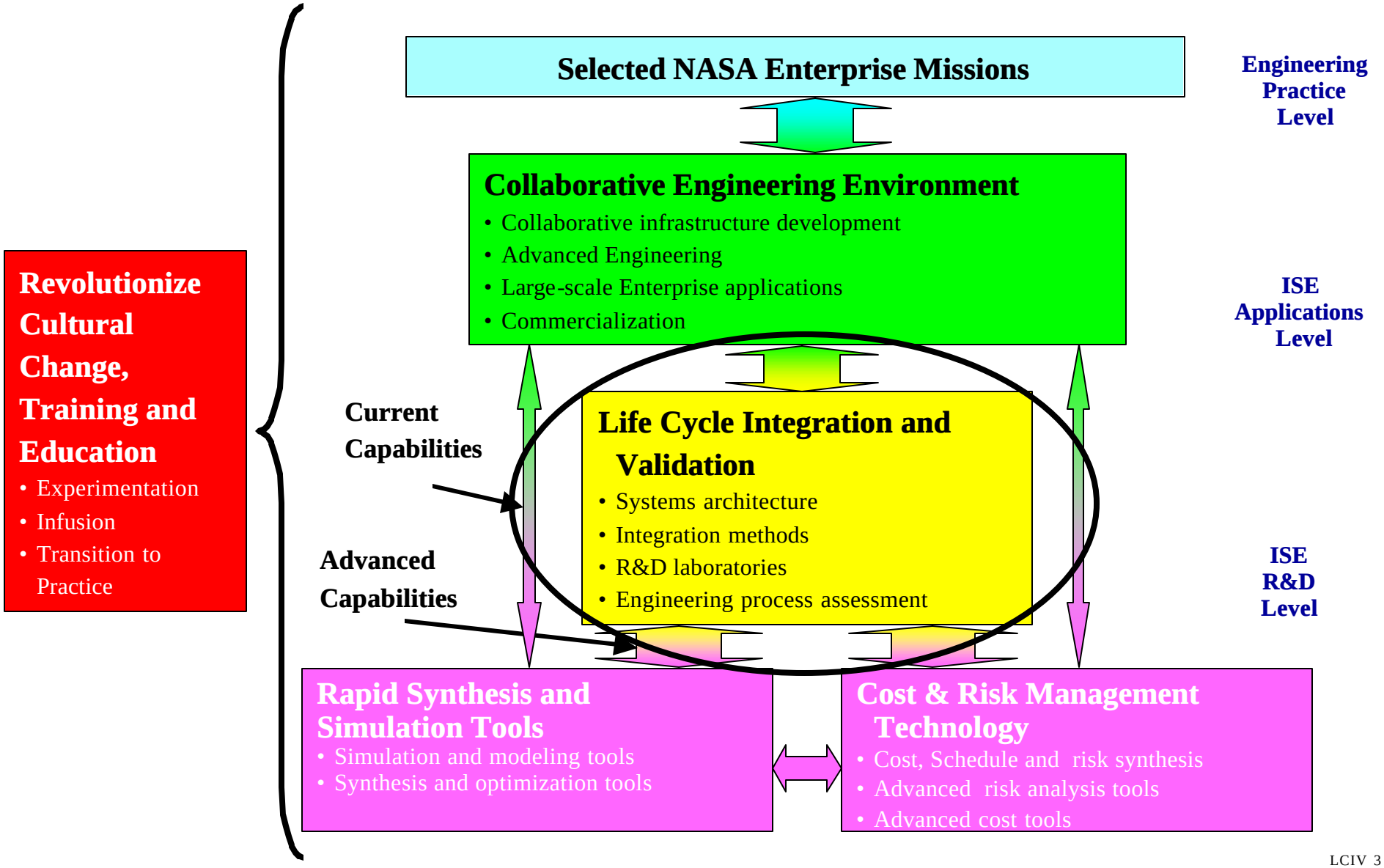


Plug & Play in Virtual Reality Environment

Collaborating Organization

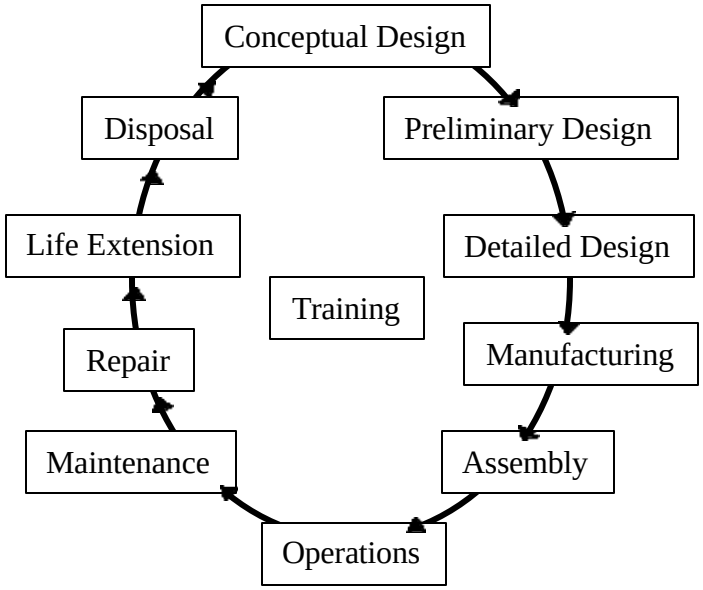
Collaborative Design Utilizing Virtual Reality Environment for Plug & Play Simulation-Based Design

Relationship Between ISE Elements



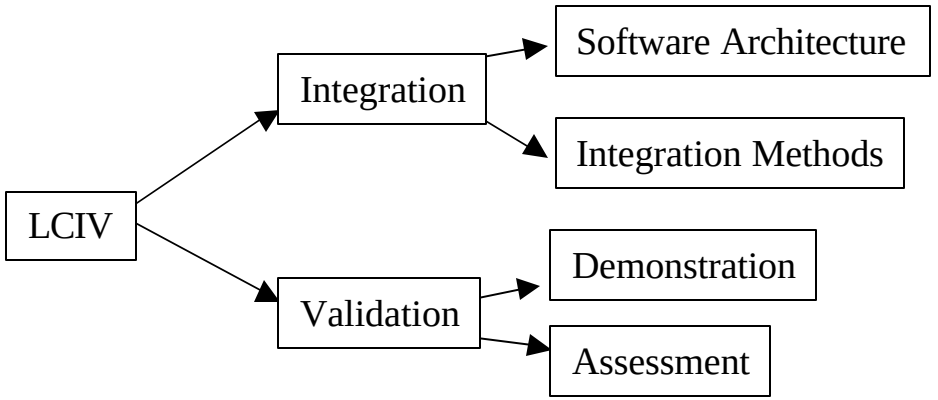
Life-Cycle Integration and Validation Problem Statement

Life Cycle



Analysis and design system that addresses the entire life-cycle of a project or mission.

Element comprised of two major tasks, each of which is divided into two sub-tasks



Develop, demonstrate and validate an advanced, integrated engineering, science, and operations environment for end-to-end life-cycle simulation

System Architecture Problem Statement

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Current Problem

- No software architecture currently available that satisfies life-cycle requirements.
- Infrastructure to enable dynamic, self discovering interfaces does not exist
- Competing standards exist with limited bridging technology available
- Software object model rarely used for tools development

Objectives/Impacts

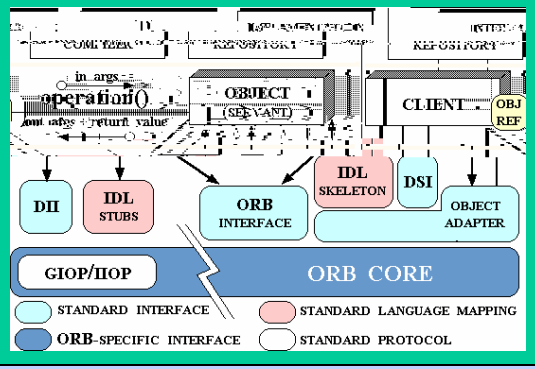
- Enable "Plug and Play" integration
- Manage workflow for life-cycle analysis capability
- Drastically reduce the time for problem setup and execution
- Enable collaboration and distribution within a life-cycle analysis
- Provide services (e.g. security, DBMS, optimizers)
- *Impact*: Enable the development of software system to revolutionize design and simulation throughout the product life-cycle

Participants

Customers:
- NASA HQ
- Other ISE Elements
- Enterprise
- Program Offices

Users:
- NASA Workforce
- Other Gov. Agencies
- Industry Partners
- Academic Partners

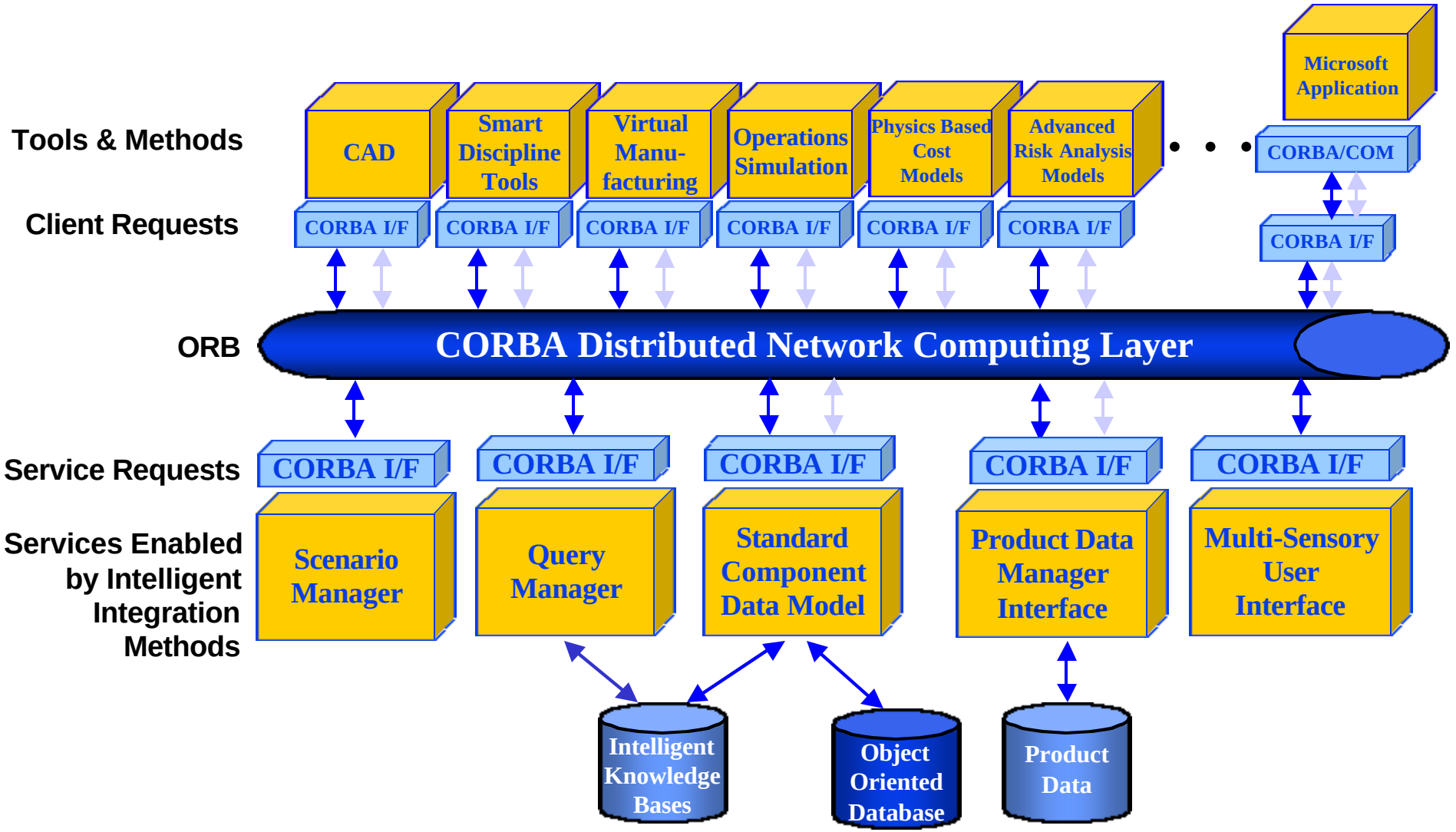
Products/Services



High-performance, common computational framework that enables non-sequential, seamless integration of life-cycle analysis design tools through "plug and play" interfaces

Systems Architecture Background

- **Loss of corporate knowledge base mandates knowledge capture and reuse.**
- **The systems architecture comprises the underlying infrastructure upon which the intelligent synthesis environment will be realized.**
  - They will provide an intelligent "plug and play" integration capability for modularized open-architecture design systems so that leading-edge life-cycle tools from government labs, industry, software vendors and academia can be readily integrated.
  - The architecture will enable flexible, dynamic, and adaptable design systems that easily incorporate new technologies.
- **The need to integrate a wide variety of incompatible architectures (e.g. Legacy systems) is driven by required innovations of design, modeling, analysis, and verification.**


Tools & Methods
Client Requests
ORB
Service Requests
Services Enabled by Intelligent Integration Methods
CAD
Smart Discipline Tools
Virtual Manu-facturing
Operations Simulation
Physics Based Cost Models
Advanced Risk Analysis Models
Microsoft Application
CORBA/COM
CORBA I/F
CORBA Distributed Network Computing Layer
Scenario Manager
Query Manager
Standard Component Data Model
Product Data Manager Interface
Multi-Sensory User Interface
Intelligent Knowledge Bases
Object Oriented Database
Product Data

Integration Methods Problem Statement

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Current Problem

- Single discipline tools are united through a series of data translations
- Difficult to incorporate new design approaches
- Software reuse is minimized due to difficulty of interface requirements
- Integration standards are beginning to be developed
- Complex systems are analyzed at a low level of fidelity

Participants

Customers:
- NASA HQ
- Other ISE Elements
- Enterprise
- Program Offices

Users:
- NASA Workforce
- Other Gov. Agencies
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- Academic Partners

Objectives/Impacts

- Identify integration requirements of current and future applications
- Develop adaptive, easily re-configurable, self-describing application interfaces
- Minimize costs of implementation, maintenance, and reuse
- Provide maximum use of and interoperability with COTS products
- *Impact*: Enable modular life-cycle analysis system to more easily incorporate new technology modules

Products/Services

NASA ADOPTS ISO 10303 FOR DATA EXCHANGE

PDES, Inc.

Definition of integration method requirements for multi-disciplinary, multi-fidelity, heterogeneous applications and models throughout the life-cycle of a product or mission

Integration Methods Approach / Strategy

- **Establish a NASA facilitated team to develop interface standards**
- **Support the development and implementation of standards in the life cycle software architecture, for example participate in OMG(Object Management Group), STEP (PDES, Inc.)**
- **Participate on industry/academic standards committees to facilitate the evolution of ISE interface standards**
- **Coordinate with software vendors and NASA internal development teams to support integration by eliminating need for software wrappers**
- **Develop recommendations and approaches for application programmable interfaces (APIs) that utilize standards and architecture services**

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OMG

UNIFIED MODELING LANGUAGE™

CORBA™

JAVA

Java™ RMI

LCIV Integration Activities Outside ISE

- **NASA**
  - Develop a Level 2 working relationship with IS/HPCC/IT Base Programs and the Code S TAM for NGIS to ensure that their products are integrated into ISE by providing LCIV representation on their working groups.
  - Establish a working relationship with the Programs identified as the focal point applications for the R&D Labs by including application representative on R&D technical team.
- **Other Government Agencies**
  - Work with OGA's through tech teams and workshops to identify which existing standards and practices should be implemented into ISE and work on the development of new standards and practices where necessary.
  - Develop a Level 2 working relationship with NIST, etc. to ensure that their products are integrated into ISE.

LCIV Integration Activities Outside ISE (cont'd)

- **Industry (Manufactures, Vendors, Operators)**
  - Ensure the involvement and advice of representatives of the virtual reality, immersive collaboration community through tech teams and LCIV membership in industry tech organizations.
- **International**
  - Using NASA steering committees, work with standards organization to identify which existing standards should be implemented into ISE and work on the development of new standards where necessary.

R&D Laboratory Problem Statement

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Current Problem

- Single user tools - little or no collaboration
- Interface via keyboard, mouse, 2D display
- Difficult to learn/master
- Complex data difficult to visualize/interpret
- Disconnects in design process, unknown downstream effects

Participants

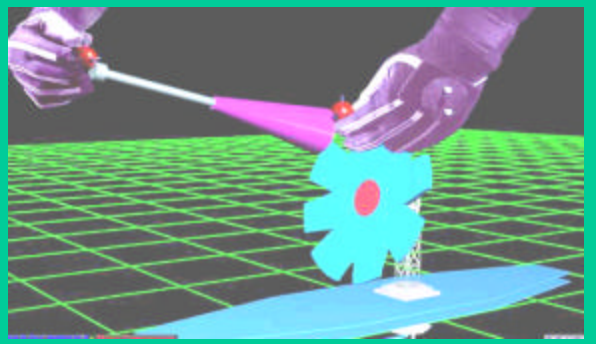
Customers:
- NASA HQ
- Enterprise
- Program Offices

Users:
- NASA Workforce
- Other Gov. Agencies
- Industry Partners
- Academic Partners

Objectives/Impacts

- Research and demonstrate advanced immersive, VR and collaborative technologies/techniques
- Infuse technology from OGAs, industry, and academia
- Serve as testbed for new LCIV integration architectures
- Assess engineering and science benefits of validated new environments
- *Impact*: Geographically distributed, collaborative, virtual environment technology to revolutionize design and simulation throughout the product life-cycle

Products/Services



Demonstrated immersive, multi-sensory design and simulation environment for the complete life-cycle

R&D Laboratories Strategy / Approach

- **Establish R&D Labs at selected centers**
  - May or may not be same/compatible architecture
  - Not just hardware, labs include people
- **Labs will collaborate but may emphasize different focus/concentration**
  - LCIV architecture and integration methods
  - Integration of science and engineering
  - Immersive design/analysis
  - Immersive Collaboration and distributed design
- **Leverage existing activities**
  - IS, NGIS, OGAs (DOE, NIST, DOD, etc.), industry, and academia
- **Research immersive/VR hardware/software and their use in life-cycle analysis**
  - talk to end users in industry
  - document engineering benefits and lessons learned

R&D Laboratories Strategy / Approach (Cont'd)

- **Develop proof-of-concept VR applications**
  - Establish engineering/science benefit within R&D Labs WG for constructive feedback
  - Evaluate engineering/science feedback using benchmarks from Process Assessment WG
- **Focus on both pull and push technology**
  - Pull requirements from ISE testbeds via CEE
  - Push technology that is useful to other programs (NGST, REVCON, UEET, Spaceliner 100, etc.)

Engineering Process Assessment Problem Statement

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Current Problem

- Process and knowledge capture has been minimal for most NASA projects
- Automated process tools are not used
- Functional decomposition vs. objects
- Lack of quantifiable metrics for new technology insertion

Participants

Customers:
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- Enterprise
- Program Offices

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Objectives/Impacts

- Benchmark existing "as is" engineering processes for the large scale applications
- Develop data flow of existing processes in support of life-cycle analysis definition and facilitate knowledge capture
- Prepare data dictionaries for life-cycle simulations in the R&D laboratories
- Assess engineering and science benefits of validated new environments
- *Impact*: Quantification of benefit of new technology to design and simulation throughout the product life-cycle provides evaluation criteria for high fidelity trades

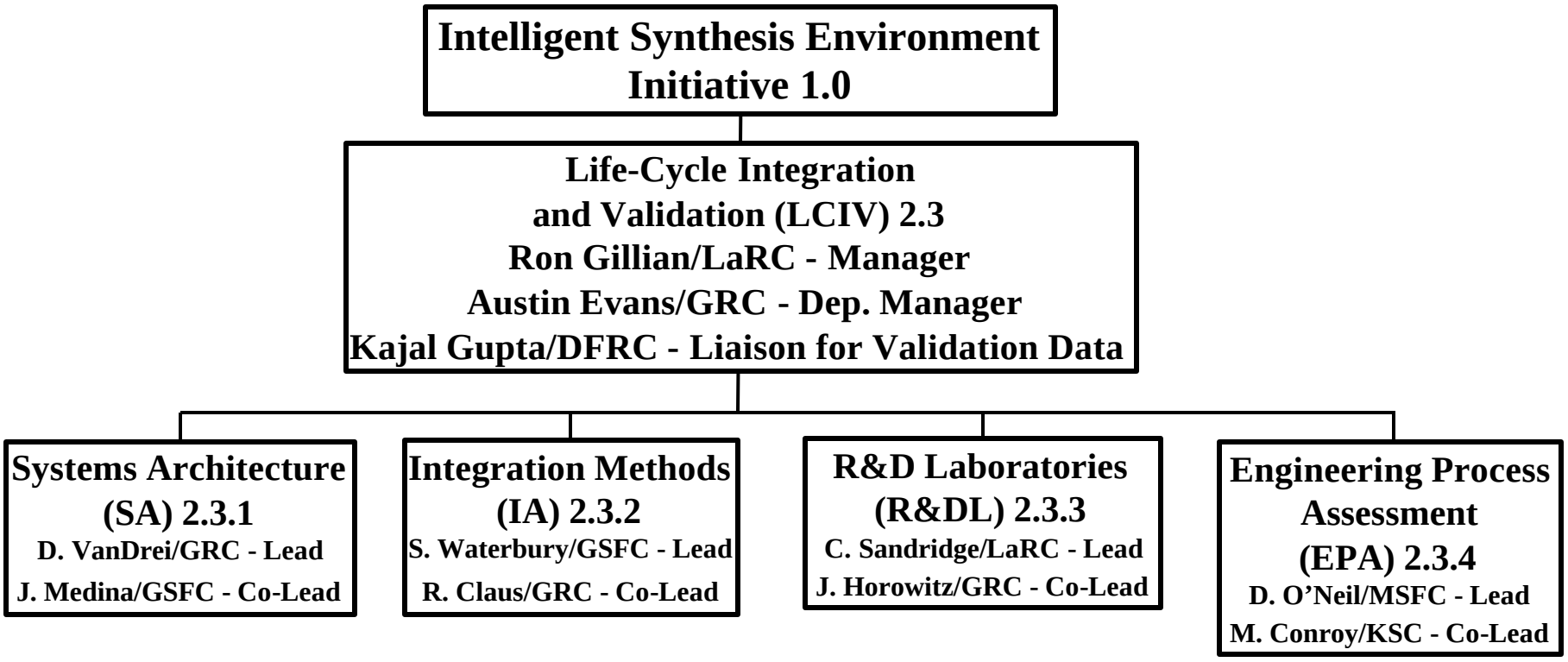
Products/Services

Demonstrated and evaluated benefits from life-cycle analysis capability and results of addition of ISE Technology

Engineering Process Assessment Approach

- **Establish a network of engineering process assessment experts**
  - Team must comprise members from each of the ISE elements
  - Identify one or more methodologies for documenting processes & select associated CASE tools
  - Work with revolutionize cultural change, training & education (RCCTE) to develop process modeling curriculum
- **Gather data for developing process models**
  - Establish a web accessible library for archiving documented processes
  - Identify currently documented processes to be used in ISE testbeds
  - Collect ISO 9000 organizational work instructions (OWI) associated with above processes
  - Interview domain subject experts, e.g., Team leaders
  - Determine input, process, and outputs for each step in engineering process
  - Collect example data and metadata, e.g., Sources, timestamps, assumptions

LCIV Organization Structure



LCIV Summary

- **Life-cycle integration and validation is a key element in the ISE program activity and is essential to accomplishing ISE long range goals**
- **Software system architecture and integration methods are required providing cost effective solutions for life-cycle analysis**
- **R&D laboratories provide a unique computational platform on which to demonstrate and validate life-cycle analysis capabilities**
- **The engineering process assessment element provides the quantification of benefits as well as guidance in selecting high payoff research**